

PUERTO RICO AND VIRGIN ISLANDS
PRECIPITATION FREQUENCY PROJECT

Update of *Technical Paper No. 42* and *Technical Paper No. 53*

Twenty-second Progress Report
1 October 2005 through 31 December 2005

Hydrometeorological Design Studies Center
Hydrology Laboratory

Office of Hydrologic Development
U.S. National Weather Service
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Update of *Technical Paper No. 42* and *Technical Paper No. 53*

1. Introduction

The Hydrometeorological Design Studies Center (HDSC), Hydrology Laboratory, Office of Hydrologic Development of NOAA's National Weather Service is updating its precipitation frequency estimates for Puerto Rico and the U.S. Virgin Islands. Current precipitation frequency estimates for the area are contained in *Technical Paper No. 42* "Generalized estimates of probable maximum precipitation and rainfall-frequency data for Puerto Rico and Virgin Islands" (U.S. Weather Bureau, 1961) and *Technical Paper No. 53* "Two- to ten-day rainfall for return periods of 2 to 100 years in Puerto Rico and Virgin Islands" (Miller, 1965). The new project includes collecting data and performing quality control, compiling and formatting datasets for analyses, selecting applicable frequency distributions and fitting techniques, analyzing data, mapping and preparing reports and other documentation.

The project will determine annual precipitation frequencies for durations from 5 minutes to 60 days, for average recurrence intervals from 1 to 1,000 years. The project will review and process all available rainfall data for the Puerto Rico and Virgin Island project area and use accepted statistical methods. The project results will be published as a Volume 3 of NOAA Atlas 14 on the internet (<http://www.nws.noaa.gov/ohd/hdsc>) with the ability to download digital files.

The project area covers Puerto Rico and the U.S. Virgin Islands of St. Thomas, St. John and St. Croix. The project area is currently divided into 9 regional groups for long duration (24-hour through 60-day) analyses (Figure 1) and 4 regional groups for short duration (60-minute through 12-hour) analyses (Figure 2).

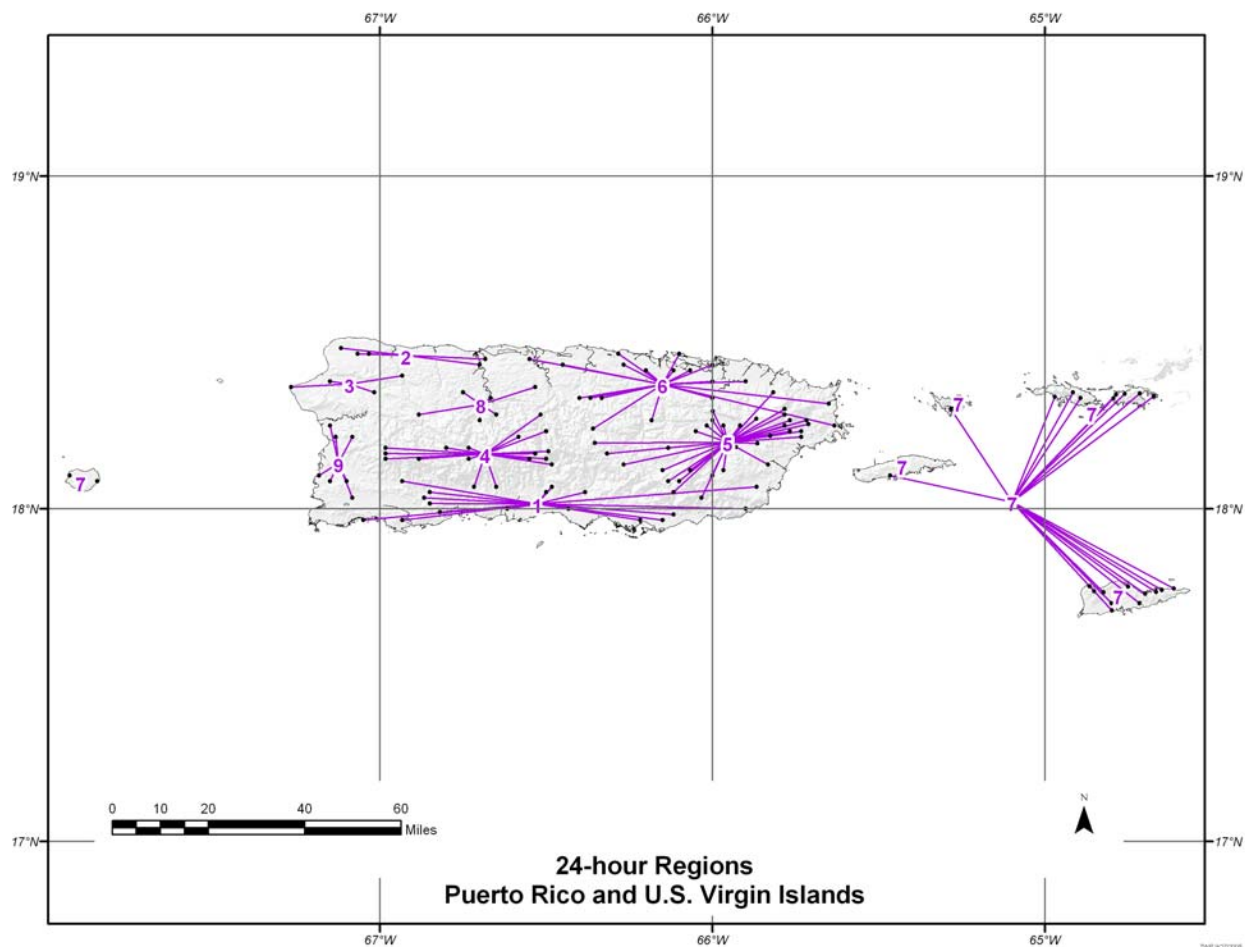


Figure 1. Puerto Rico Precipitation Frequency project area and 9 regional groups based on 24-hour data.

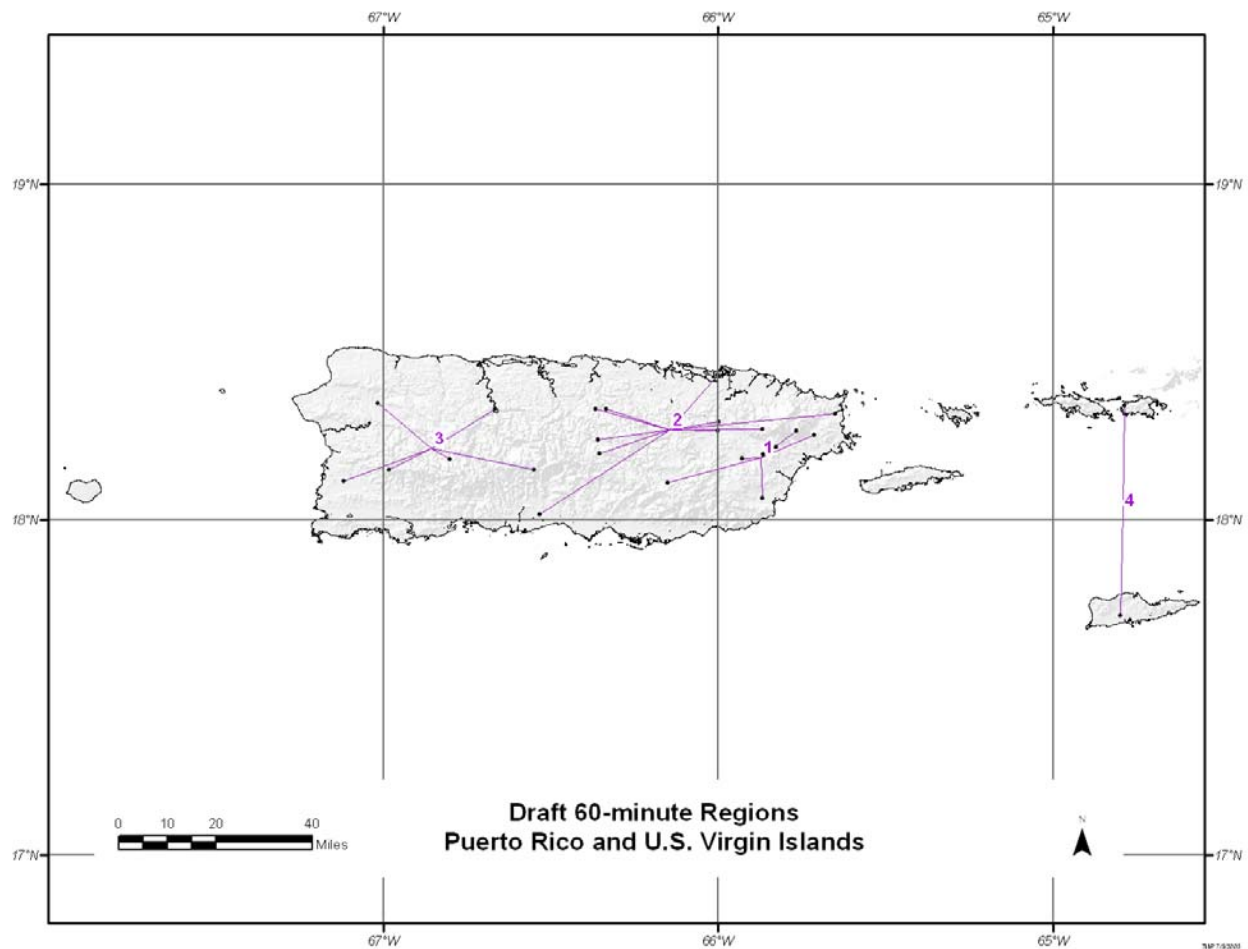


Figure 2. Puerto Rico Precipitation Frequency project area and 4 regional groups based on 60-minute data.

2. Highlights

A peer review of the draft results for the Puerto Rico and U.S. Virgin Islands Precipitation Frequency Project began November 3rd, 2005. The review included the point precipitation frequency estimates and confidence limits for all observing sites and four spatially interpolated maps. The review will conclude on January 11th, 2006. Roughly eight responses have been received thus far. The peer review is one of the keys to ensuring the quality of the estimates. Additional information is provided in Section 3.7, Peer Review.

Final quality control of the data was completed during this reporting period. QCseries output were reviewed for the daily durations' partial duration series and for the hourly durations' annual maximum and partial duration series. No data errors were found. Annual maximum consistency from one duration to the next was verified and cases where differences for a given year exceeded 10% were checked for data quality. The investigation of cross-correlation between stations was completed with the assessment of the 1-day, 10-day and 30-day annual maximum series data. The impact of correlated stations on final quantiles (2-, 10-, 100-, and 1,000-year) was minimal (<3.5%) and similar between the durations. In addition this quarter, several station quality issues were addressed. The longitude for station 66-5123 (La Muda Caguas) was corrected. One daily station (66-4115 Guavate Camp) was deleted due to a short record and poor data quality. Additional information is provided in Section 3.1, Data Quality Control.

N-minute ratios were computed to generate n-minute results at all hourly stations because of the limited n-minute data available. Additional information is provided in Section 3.2, N-minute Ratios.

Prior to the peer review, hourly regions were revised slightly to mitigate spatial bull's eyes and steep spatial gradients observed in the 60-minute 100-year maps and produce more climatologically reasonable results. Additional information is provided in Section 3.3, L-moments and Regionalization.

Ratios to convert annual maximum series results to partial duration series results were computed. Additional information is provided in Section 3.4, PDS/AMS Ratios.

1-hour distributions will be included in the final results for the temporal distributions of heavy rainfall analysis. The temporal distributions were included as part of the peer review. Additional information is provided in Section 3.5, Temporal Distributions.

Internal review of preliminary 100-year 60-minute spatially-interpolated estimates showed several bull's eyes and contours closely drawn to stations reflecting a strong station influence rather than a reasonable climatological pattern. Several measures were taken, including using a lower resolution for the smoothing of normalized residuals used in mapping and computation of hourly pseudo data (i.e., quantiles) at all daily-only stations to increase information in areas void of hourly stations. The Spatial Climate Analysis Service (SCAS) at Oregon State University recomputed spatially interpolated

60-minute and 24-hour mean annual maximum grids based on decisions made regarding specific stations that seemed inconsistent. Additional information is provided in Section 3.6, Spatial Interpolation.

HDSC continuously monitors the hits, integrity and performance of the Precipitation Frequency Data Server (PFDS), the on-line portal for all NOAA Atlas 14 deliverables and information. Additional information is provided in Section 3.8, PFDS.

Progress on the development of areal reduction factors remains slow. Additional information is provided in Section 3.9, Areal Reduction Factors.

3. Progress in this Reporting Period

3.1 Data Quality Control

QCseries. QCseries, the spatially-based software that screens data series to identify maximum precipitation values that are suspect relative to concurrent data at nearby stations, was used to provide further quality control of the daily durations (1-day through 60-day) partial duration series (PDS) data and hourly durations (1-hour through 12-hour) annual maximum (AMS) and partial duration series data (see the 21st Progress Report for details on the method). Only the 1-day, 2-day, 4-day, 10-day and 60-day PDS data were checked since no errors were found in these durations and all durations of the AMS data (1-day through 60-day) were previously checked. Similarly, the 1-hour, 2-hour and 6-hour durations of the hourly AMS data were checked and the 1-hour and 6-hour PDS durations were checked. (The 1-hour and 6-hour PDS were used in evaluation of the AMS to PDS ratios.) No errors were found.

Annual Maximum Consistency. Consistency in the annual maximum series from one duration to the next is ensured through the annual maximum consistency check and adjustment. Inconsistencies where an annual maximum of a shorter duration was greater than the next longer duration in a given year can happen when average adjustment factors that account for different sampling intervals are applied (e.g., 1-day to 24-hour data). It can also happen when the data has too many missing values for the longer duration to be extracted.

Twenty-one cases where the difference was more than 10% were inspected for any data quality issues. The 10% cutoff was chosen as a convenient indicator above which the cause is generally missing data. There were six cases where the 1-day was greater than the 2-day maximum as a result of the conversion factor from 1-day to 24-hour data (1.208) or because the maxima was from a year where only monthly maximums had been hand-entered and no 2-day could be extracted. There were 15 cases where the 2-day was greater than 4-day because of the conversion factor from 2-day to 48-hour (1.134). No data errors were found in the raw data for these cases. There were no cases in durations longer than 4-day.

There were two stations (66-8808 and 66-9763) where the highest three 1-day annual maximums were hand-entered and were greater than the highest three 2-day maximums. It is being considered whether to add data surrounding these events so that they can be included in longer duration series.

In these quality controlled cases and if the difference was small (<10%), the longer duration annual maximum was set equal to the shorter duration maximum for that year during an annual maximum consistency adjustment applied to the series data before the L-moment analyses were run.

Cross-Correlation. Since it is assumed for precipitation frequency analysis that events are independent, 1-day annual maximum series data were investigated for cross-

correlation between stations to assess intersite dependence as reported in the Twenty-first Progress Report. In addition, the 10-day and 30-day durations were similarly assessed. Cases in each of the nine daily regions where 10-day or 30-day annual maxima overlapped (+/- 5 or 10 days, respectively) at stations within 50 miles and with more than 20 years of concurrent data were analyzed using a t-test for correlation coefficients that were statistically significant at the 90% confidence level.

It was found that the degree of cross-correlation between stations for their annual maximum data in the project area was low regardless of duration. There was a slightly higher percentage of stations that were correlated at longer durations (Table 1). However, there were fewer stations overall (due to stations with limited hand-entered monthly maximums not being available for longer durations). Overall, less than 9.3% of the annual maximum data itself showed significant correlation based on t-test results for the tested durations.

Most importantly, the impact of these correlated stations on the final quantiles (2-, 10-, 100-, and 1,000-year) was minimal (<3.5%) and similar between the durations (Table 1). Relative errors were calculated for regions with any degree of cross-correlation of stations. For these regions, the quantiles from an analysis using all stations versus an analysis using only stations that were not cross-correlated were compared. The average relative errors in quantile estimation were small (Table 1). These results suggest that it is not necessary to embed any measures to address dependence structures in the data.

Table 1: Average percentages of correlated stations and data and the absolute average of the percent impacts on the final 2-, 10-, 100- and 1,000-year quantiles for the 1-day, 10-day, and 30-day cross-correlation analyses.

| region | % of stns. Correlated* | Total N of stns. | Corre. N of stns. | % of corre-lated data** | Impact of cross-correlation on quantiles | | | |
|--------|------------------------|------------------|-------------------|-------------------------|--|---------|----------|----------|
| | | | | | 2-year | 10-year | 100-year | 10K-year |
| 1-day | 19.45 | 127 | 30 | 6.49 | 0.4% | 0.4% | 1.3% | 2.2% |
| 10-day | 28.18 | 110 | 36 | 9.21 | 0.6% | 0.3% | 1.9% | 3.3% |
| 30-day | 25.98 | 112 | 33 | 8.76 | 0.4% | 0.4% | 1.3% | 2.2% |

* "% of stns correlated" is the percentage of correlated stations to the total number of stations in a region and may be less than (Correlated number of stations/total number of stations) since a given station may be correlated with one or more other stations.

** "% of correlated data" is the percentage of cross-correlated annual maximum data to the total number of data years in a region.

Station Issues. It was found that the longitude for station 66-5123 (La Muda Caguas) was incorrect. It was changed from -65.7833 to the correct longitude of -66.1000.

During an assessment of the spatial gradients between stations in the 24-hour means and 100-year estimates, one station, 66-4115 (Guavate Camp) was identified as anomalously low. This station had only 22 years of data and many questionable or missing data (more than 15% were missing). This station was also identified through

regression techniques during the PRISM process (see Section 3.6 Spatial Interpolation) as being anomalous. Therefore this station was deleted.

3.2 N-Minute Ratios

N-minute data are precipitation data measured at a temporal resolution of 5-minutes that can be summed to various “n-minute” durations (10-minute, 15-minute, 30-minute, and 60-minute). Because of the small number of n-minute data available, n-minute precipitation frequencies are estimated in this project by applying a linear scaling to 60-minute data at hourly stations. The linear scaling factors were developed using ratios of n-minute quantiles to 60-minute quantiles from co-located n-minute and hourly stations.

There was only one n-minute station available in the project area, San Juan (66-8812), which had only 27 years of data. There were 25 National Weather Service 15-minute stations also available (Figure 3).

Unfortunately, the 15-minute and 30-minute ratios derived from the single n-minute station were inconsistent (higher) than those derived from the 25 15-minute stations. Through a careful investigation, the results from the 15-minute stations were deemed more reliable than the ratios from the single n-minute station for numerous reasons. They were based on more data/stations and were more consistent with expectations. The ratios from the 15-minute stations followed the expected pattern in which the ratios decreased with rarer return frequencies, whereas the n-minute station did not. Ratios from an analysis of n-minute ratios for three North Carolina and South Carolina coastal stations (which had 89 to 105 data years and were impacted by hurricanes to some degree) were of the same magnitude as the ratios from the 15-minute stations. The 15-minute stations also provide a greater geographic representation of the island than the single n-minute station (San Juan). The San Juan station had consistently lower precipitation frequency estimates probably due to strong coastal effects that suppress convection.

To obtain a full set of n-minute ratios (5-minute through 30-minute) (Table 2), a combined approach was utilized. The 30-minute and 15-minute ratios were derived from the 15-minute and n-minute station analyzed as one region. One region (rather than in the 4 hourly regions) was used to provide more robust results due to the limited number of stations in each region. These 15-minute and 30-minute ratios were then used to anchor the 5-minute and 10-minute ratios which were obtained from the slope of the ratios derived from the single n-minute station (Figure 4). This approach was reviewed by meteorologists in the NWS Weather Forecast Office in Puerto Rico.

In this analysis the quantiles were computed using the Generalized Normal (GNO) distribution because it was best-fitting for the hourly data and the majority of n-minute durations and because there was little difference in the ratios obtained using GNO, Generalized Logistic (GLO), or Generalized Extreme Value (GEV).

Finally, it was decided to use ratios averaged over all return frequencies since there were so few data (only 16-33 years) and using ratios for each frequency was not justified.

The resulting ratios (Table 2) are different than that used in Technical Paper 42, which provided only 30-minute quantiles using a ratio of 0.79 for all calculated return periods. The current ratios are based on considerably more data from within the project area, whereas Technical Paper 42 appears to use the ratio that was used in other studies such as NOAA Atlas 2 (Miller et al., 1973) for the western United States and Technical Paper 40 (Hershfield, 1961) for the entire continental United States.

Figure 3. N-minute and 15-minute stations in the project area.

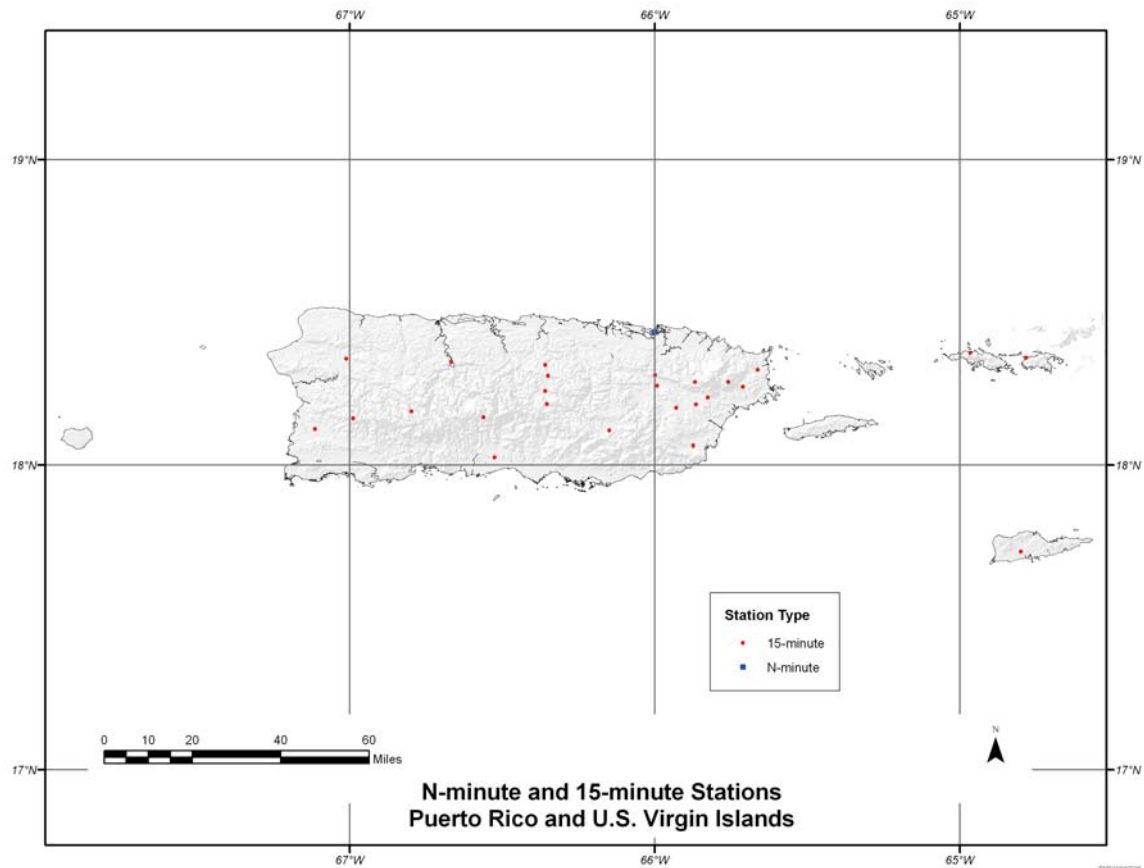


Figure 4. N-minute ratios derived for the Semiarid southwest and Ohio River basin and surrounding states and for this project from the single n-minute station, San Juan, from the 15-minute stations and from the final combined approach.

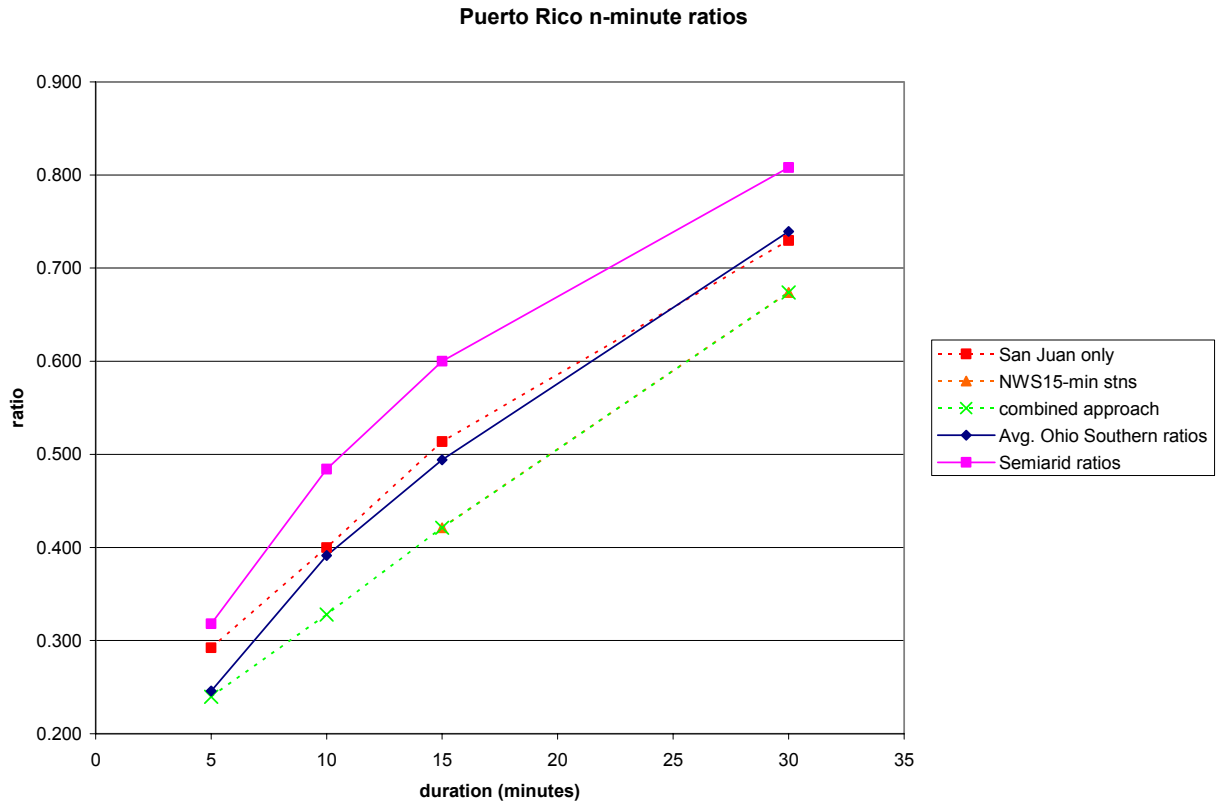


Table 2: Final n-minute ratios for the Puerto Rico project.

| duration | n-min ratios |
|----------|--------------|
| 5 | 0.240 |
| 10 | 0.328 |
| 15 | 0.421 |
| 30 | 0.674 |

3.3 L-moments and Regionalization

Low spatial bull's eyes in the 100-year 60-minute map spurred an investigation into two hourly stations (66-3113 and 66-3657) that appeared anomalously low relative to nearby stations. Both stations were on the border between hourly regions 1 and 2 (Figure 2). Station 66-3113 (Cubuy) is a high elevation station that had low estimates compared to nearby stations and was heavily influencing the contouring. Review suggested that it should have higher estimates due to its elevation. Station 66-3657

(Fajardo) is an east coastal station that had a low bull's eye. The L-statistics at this station were very much like region 1 and review suggested that it may not be consistent with other coastal stations due to its surrounding terrain.

Both stations were moved from region 2 to region 1. The move yielded homogeneous regions and more reasonable estimates with smoother spatial patterns. In region 1, the 100-year and 1,000-year 60-minute estimates decreased 4.5% and 8.3%, respectively. This reasonably reduced this area which was a maximum in the 60-minute maps. In region 2, the 100-year and 1,000-year 60-minute estimates decreased negligibly, only 1.5% and 1.9%, respectively. The 100-year and 1,000-year estimates at stations 66-3113 and 66-3657 increased considerably (18% and 27%, respectively) to be consistent with nearby stations.

3.4 PDS/AMS Ratios

Annual maximum series (AMS) data consist of the largest case in each year, regardless of whether the second largest case in a year exceeds the largest cases of other years. In this project, the partial duration series (PDS) data is a subset of the complete data series where highest N cases are selected and N equals the number of years in the record.

AMS data were used to compute quantiles for all durations from 5-minute to 60-day and for annual exceedance probabilities of 1 in 2 to 1 in 1,000. The use of the AMS data is consistent with the concept of frequency analysis and the manipulation of annual probabilities of exceedance, and is consistent with the basis of development of the statistics used in this project. The statistical approach is less well demonstrated for PDS data. However, to remain consistent with the previous studies (e.g., Technical Paper 42) and to meet today's needs at lower return periods, the results will also be presented in terms of PDS.

PDS results were obtained by analyzing both 24-hour AMS and PDS data separately, averaging ratios of PDS to AMS quantiles and then applying the average ratio to the AMS results. The PDS/AMS ratios were developed by independently fitting distributions to AMS and PDS data separately for each region before averaging. Figure 5 shows the average results of the PDS/AMS ratios for 24-hour data over the 9 homogenous regions in the project area. To account for sampling variability and to generate a smooth consistent curve, an asymptote of 1.010 was applied for 50-year and above, particularly since the difference in the third decimal place has very little impact on the quantiles. The final ratios for this project and for previous projects are listed in Table 3.

The use of the 24-hour duration is consistent with methods used in previous projects. It is the most reliable duration with the least uncertainty. The results are consistent with expectations and with previous projects. The 1-hour, 6-hour, 7-day and 60-day durations were also analyzed and their resulting ratios were consistent with the 24-hour duration.

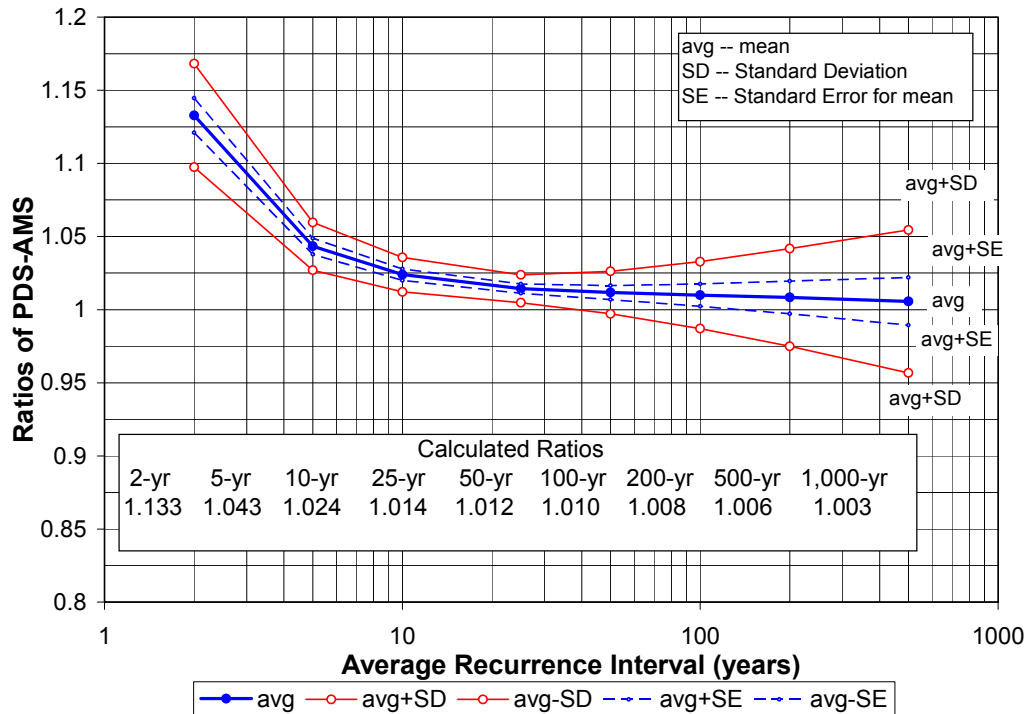


Figure 5. PDS-AMS ratio results for average recurrence intervals for the 24-hour duration over the 9 homogeneous regions in this project.

Table 3. Final PDS/AMS ratios for NOAA Atlas 14 projects, including Puerto Rico with asymptotes applied.

| | 2-year | 5-year | 10-year | 25-year | 50-year | 100-year | 200-year | 500-year | 1,000-year |
|--|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| NA14 Vol. 1 Semiarid southwest | 1.113 | 1.029 | 1.013 | 1.006 | 1.004 | 1.004 | 1.004 | 1.004 | 1.004 |
| NA14 Vol. 2 Ohio River basin and surrounding states | 1.086 | 1.023 | 1.010 | 1.004 | 1.004 | 1.004 | 1.004 | 1.004 | 1.004 |
| NA14 Vol. 3 Puerto Rico and U.S. Virgin Islands | 1.133 | 1.043 | 1.024 | 1.014 | 1.012 | 1.010 | 1.010 | 1.010 | 1.010 |

3.5 Temporal Distributions

Temporal distributions for the 6-, 12-, 24- and 96-hour durations have been completed and were discussed in the 21st Progress Report. In addition, temporal distributions for the 1-hour duration were computed with data from twenty-four 15-minute stations. Since the input data is constrained by 15-minute observations, the 1-hour duration only contains four observations compared to twenty-four 15-minute observations for the 6-hour duration. After observing that the 1-hour distributions were relatively smooth and consistent and evaluating the usefulness of such a duration to users in Puerto Rico, it was decided to include the 1-hour in the final results with a caveat recognizing that the curves were derived from only four points. The temporal distributions were included as part of the peer review (http://hdsc.nws.noaa.gov/hdsc/pfds/pr/NA14Vol3_A1.pdf).

3.6 Spatial Interpolation

Spatial Smoothing. Prior to the peer review, an internal review of preliminary 100-year 60-minute spatially-interpolated estimates showed several bull's eyes and contours closely drawn to stations reflecting a strong station influence rather than a reasonable climatological pattern. The spatial patterns of the PRISM-created mean annual maximum 60-minute grid are smoothed and do not indicate a lot of variation, therefore when the spatially variable 100-year 60-minute precipitation frequency estimates were derived from this relatively smooth pattern, bull's eye patterns develop around the stations. Coupled with the fact that the shorter duration (<24-hour) dataset was relatively small, the resulting 100-year 60-minute grid contained spatial patterns that were highly driven by the stations and their locations. It was clear that the limited dataset was not sufficient to accurately resolve important short duration patterns at a high spatial resolution (3-seconds). To create smooth contours, several measures were taken in the spatial interpolation process used to derive the precipitation frequency grids. (Additional information on the spatial interpolation method can be found in the NOAA Atlas 14 Vol. 2 documentation: http://hdsc.nws.noaa.gov/hdsc/pfds/docs/NA14Vol2_4spatial.pdf.)

First, for the shorter duration(<24-hour) maps, increased smoothing was applied to the normalized residuals, which are the differences between the precipitation frequency estimates from the generalized all-region Regional Growth Factor ratios and the actual precipitation frequency estimates at each station, divided by the mean. The residuals account for station-specific differences and are spatially consistent within the regions. This increased smoothing was achieved by decreasing the spatial resolution from 3-seconds to 9-seconds before spatially interpolating the normalized residuals with an inverse distance weighting algorithm. Sensitivity tests were conducted to determine the optimum resolution to use to avoid "over-smoothing" the estimates which would cause the maps to deviate significantly from the quantile estimates achieved through the L-moment analysis. The results were then re-sampled to the 3-second resolution.

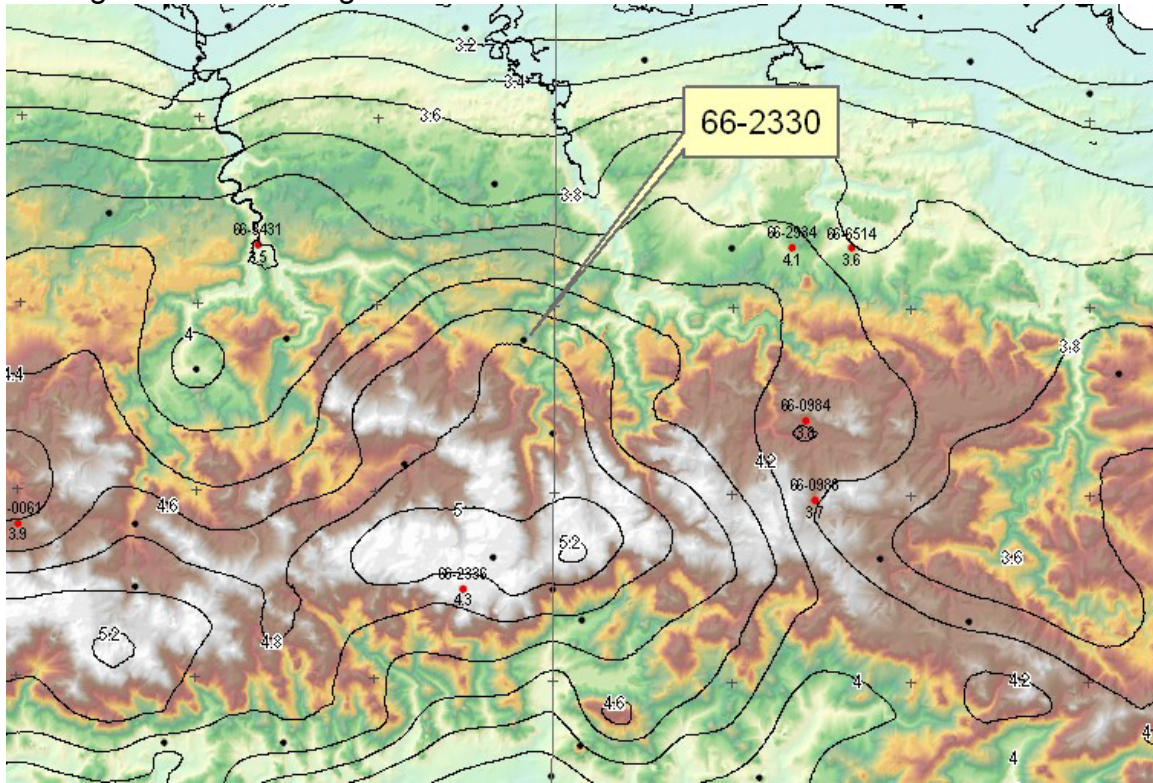
Second, it was clear that the limited shorter duration dataset was not sufficient to accurately resolve patterns at the final high spatial resolution (3-sec), therefore so-called hourly “pseudo data” were objectively generated at all daily-only stations to create a more coherent spatial pattern in the hourly durations. Pseudo data are objectively computed quantiles that are inherently consistent with existing co-located stations. Pseudo data are generated by applying a ratio of x-hour quantiles to 24-hour quantiles that is spatially interpolated using an inverse-distance-weighting algorithm based on only co-located daily/hourly stations. The interpolated ratio is then applied to the daily-only 24-hour quantiles to generate the hourly pseudo data at that station location. The mitigation provides a smoother, more meteorologically-sound transition from hourly to daily precipitation frequency estimates.

Experience has shown that since each daily and hourly duration is computed independently and from a different set of stations, it is possible for inconsistencies from duration to duration at a given spatial location to occur, particularly at daily-only or hourly-only station locations. As was done in previous projects, this is resolved using the pseudo data.

Ultimately, it was decided to create hourly pseudo data at all daily-only stations in the project area because hourly data in the project area were spatially very limited over very complex terrain. This dramatically increased the shorter duration dataset by 110 stations (from 25 to 135 stations) thereby providing the station density necessary to accurately resolve important spatial patterns that would have otherwise been undetected. Adding such data reduces uncertainty in areas otherwise void of hourly data. The general 100-year 60-minute patterns did not change with the addition of the pseudo data, with one exception – in the middle of the island, estimates in/around 66-1142 increased 18.4%. This increase occurs in an area that was previously lacking hourly data. The resulting spatial pattern is more consistent with climatological expectations and with Technical Paper 42. Including similar pseudo mean values to PRISM will be considered before the final spatial interpolation is conducted.

Daily-only station 66-2330 (Cerro Gordo Ciales) was excluded from the pseudo data because it was unnecessarily increasing estimates in that area. Of the 110 pseudo stations this was the only one that exhibited unusual behavior. The resulting pattern (Figure 6) is more consistent with climatological and topographical expectations. Given that the station is lower in elevation and on the downslope of the ridgeline relative to nearby stations, it is expected to have lower precipitation.

Figure 6. Contours of 100-yr 60-min when 66-2330 is excluded from the pseudo data. The background of the image is elevation.



PRISM. SCAS delivered the PRISM-interpolated 60-minute and 24-hour mean annual maximum precipitation grids to HDSC on September 23, 2005. During the PRISM interpolation process of the 60-minute grid SCAS identified several stations as having inconsistent means as compared to what would be expected according to their analysis (too high or too low). (No 24-hour stations were considered inconsistent.) HDSC thoroughly investigated each of the inconsistent stations and made decisions on a course of action for each. The hourly stations investigated and the decisions made were:

1. 66-5123 (too low) – was mis-located. Longitude should have been -66.1000. Once corrected this station was no longer a problem.
2. 66-4115 (too low) – a large amount of missing or suspicious data; omitted station from analysis.
3. 66-1309 (too low) – retained because it is capturing an area of low annual maximum precipitation.
4. 66-2825 (too low) – retained because it is capturing an area of low annual maximum precipitation.
5. 66-1142 (too high) – retained for now, particularly so that reviewers could comment, but will be evaluated again since it may not be correctly representing the extreme rainfall in the area.

PRISM was re-run with the station location correction (66-5123) and station omission (66-4115). The resulting grid is included in the peer review and was the basis for the derivation of the 100-year 60-minute grid which is also under review. The 24-hour interpolation process was trouble free and produced favorable results.

3.7 Peer Review

On November 3rd, 2005 a 10 week-long peer review started. The materials under review included:

- Point precipitation frequency estimates for 136 stations
- PRISM-interpolated map of mean annual 60-minute precipitation
- PRISM-interpolated map of mean annual 24-hour precipitation
- CRAB-interpolated map of 100-year 60-minute precipitation estimates
- CRAB-interpolated map of 100-year 24-hour precipitation estimates
- Statistical Trend Analysis report
- Temporal Distributions of Heavy Rainfall Analysis report

The review materials and instructions were available via the Precipitation Frequency Data Server. E-mail notifications of the peer review were sent to 153 email addresses. The review initially concluded on December 12th, 2005 with some reviewers receiving extensions through January 11th, 2006 due to the holidays. Roughly eight responses have been received thus far. The peer review is one of the keys to ensuring the quality of the estimates. After the peer review ends on January 11th, 2006 HDSC will distribute and post a formal response to the comments received.

3.8 PFDS

The Precipitation Frequency Data Server (PFDS), the on-line portal for all NOAA Atlas 14 deliverables and information, did not undergo any changes this quarter.

HDSC continuously monitors the hits, integrity and performance of the PFDS, which continues to receive an increasing number of hits per month. The graph (Figure 7) below summarizes the number of individual data inquires made since April 2004, while the map (Figure 8) indicates the locations of inquires during the past quarter.

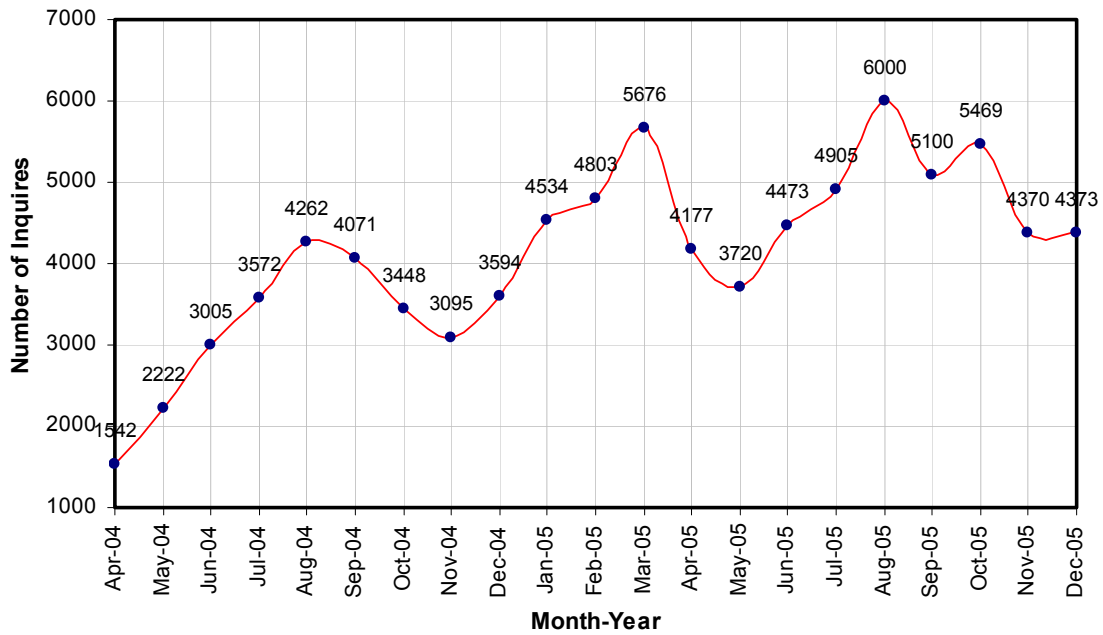


Figure 7: Number of individual PFDS data inquiries per month.

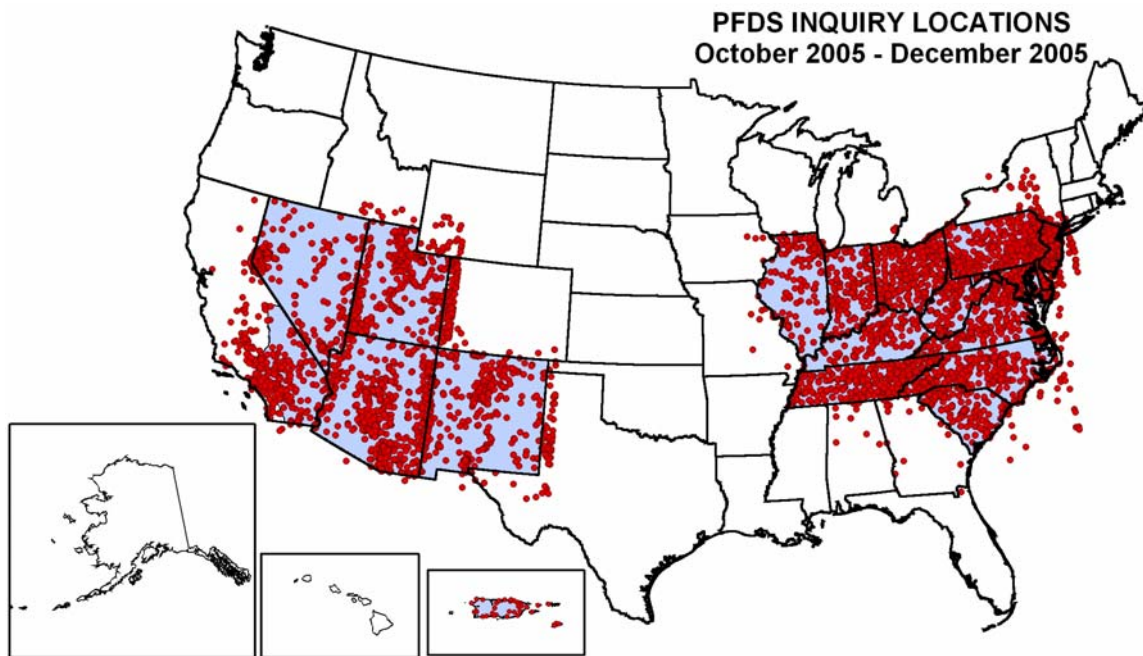


Figure 8: Map of 14,212 PFDS data inquiry locations during the period October-December 2005.

3.9 Areal Reduction Factors

Work continues in the development of geographically-fixed Areal Reduction Factor (ARF) curves for basin area sizes of 10 to 400 square miles. Progress has been slow due to difficulties in completing the software related to the general fit of the underlying ARF curves.

Additional work to locate possible additional basins for use in the ARF project continues. No new sites have been found thus far due to a lack of available and sufficiently dense data.

4. Issues

4.1 HDSC List-server

HDSC has created a list-server to send e-mail to a list of subscribers. It will replace our current process for announcements of progress reports, data updates, documentation and publications. Only HDSC personnel will be able to send messages through the server. The address list will not be available to the public. The list-server is not meant to serve as a discussion forum, but is meant to be a tool for HDSC to distribute information. Details on how to subscribe and un-subscribe from our list server are accessible through the HDSC homepage at <http://www.nws.noaa.gov/ohd/hdsc>. Be aware, if you unsubscribe you will no longer receive announcements of progress reports, documentation or data updates from HDSC.

4.2 Personnel

Ed Zurndorfer, who is the Areal Reduction Factor Project Leader, will be retiring from HDSC in January 2006. Due to budget constraints, his position will not be re-filled. There should be no delay in the release of the Areal Reduction Factors due to this transition.

5. Projected Schedule and Remaining Tasks

The following list provides a tentative schedule with completion dates. Brief descriptions of tasks to be worked on are also included in this section.

- Data Collection and Quality Control [Complete]
- Temporal Distributions of Extreme Rainfall [Complete]
- Peer Review of Spatially Interpolated Point Estimates [January 2006]
- Spatial Interpolation of Grids [April 2006]
- Precipitation Frequency Maps [May 2006]
- Web Publication [April 2006]
- Spatial Relations (Areal Reduction Factors) [April 2006]

5.1 Peer Review

A peer review began on November 4th, 2005 and will conclude January 11th, 2006. Because reviewer feedback is an integral part in ensuring HDSC develops the best possible estimates, the end date of the review had been extended from December 12th to January 11th. After evaluating and responding to reviewer comments, final estimates and spatially interpolated grids will be developed.

5.2 Spatial Interpolation

It is anticipated that HDSC will send the final annual maximum means to SCAS by January 31st, 2006. SCAS then has roughly 7 weeks according to the Statement of Work to return the final grids. Once HDSC receives the grids, the final precipitation frequency grids will be generated and internally reviewed in as timely a manner as possible.

5.3 Areal Reduction Factors (ARF)

Computations for the ARF curves will be completed in the next quarter for 14 areas. The resulting curves will be tested for differences to determine if a single set of ARF curves is applicable to the entire U.S. or whether curves vary by region.

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